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Scientists Control Human DNA with Electricity in 'Leap Forward', Study Reports

Breakthrough research represents “the missing link that will enable wearables to control genes in the not-so-distant future,” researchers say.

By Becky Ferreira

July 31, 2023, 12:25pm

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IMAGE: DA-KUK VIA GET

perform medical interventions, reports a new study.

In a novel experiment, researchers were able to trigger insulin production in human cells by sending electrical currents through an "electrogenetic" interface that activates targeted genes. Future applications of this interface could be developed to deliver therapeutic doses to treat a wide range of conditions, including diabetes, by directly controlling human DNA with electricity.

ABSTRACT breaks down mind-bending scientific research, future tech, new discoveries, and major breakthroughs.

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There is currently an explosion of interest in medical wearables, which are health-centric portable technologies such as fitness trackers, biosensors, blood pressure monitors, and portable electrocardiogram devices. Smart wearables have become an essential tool for many doctors and patients, spurring researchers to continue developing novel platforms for collecting medical data or even performing medical interventions.

Now, scientists led by Jinbo Huang, a molecular biologist at ETH Zürich, have invented a battery-powered interface that they call "the direct current (DC)-actuated regulation technology," or DART, that can trigger specific gene responses with an electric current. Huang and his colleagues described the device as "a leap forward, representing the missing link that will enable wearables to control genes in the not-so-distant future," according to a study published on Monday in *Nature*.

"Electronic and biological systems function in radically different ways and are largely incompatible due to the lack of a functional communication interface," the team said in the study. "While biological systems are analog, programmed by genetics, updated slowly by evolution and controlled by ions flowing through

expression remain the missing link in the path to full compatibility and interoperability of the electronic and genetic worlds," the researchers added.

With that in mind, the team aimed to forge a direct connection between our "analog" DNA, which is the biological alphabet that governs the life-cycles of all organisms on Earth, and the electronic systems that form the basis of digital technologies.

The same group at ETH Zürich had originally demonstrated that genes could be electrically activated as part of a study that was published in 2020. This new modified design simplifies the initial design by implanting human pancreatic cells into mice with type 1 diabetes. The researchers then used electrically-stimulating acupuncture needles to switch on the exact genes involved in regulating doses of insulin, a hormone that is essential for the treatment of diabetes. As a consequence, the blood glucose concentrations of the model mice returned to normal levels.

Huang and his colleagues said this electrical fine-tuning of mammalian gene expression sets the stage for "wearable-based electro-controlled gene expression with the potential to connect medical interventions to an internet of the body or the internet of things," according to the study.

"While we chose DART-controlled insulin production for proof-of-concept validation, it should be straightforward to link DART control to the in situ production and dosing of a wide range of biopharmaceuticals," the team concluded. "We believe simple electrogenetic interfaces such as DART that functionally interconnect analog biological systems with digital electronic devices hold great promise for a variety of future gene- and cell-based therapies."

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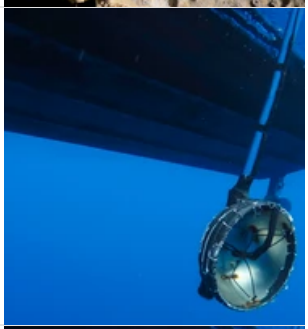

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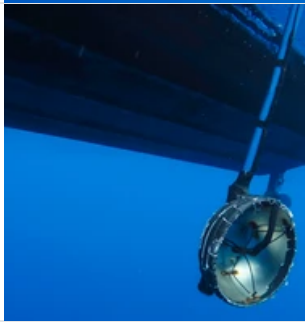

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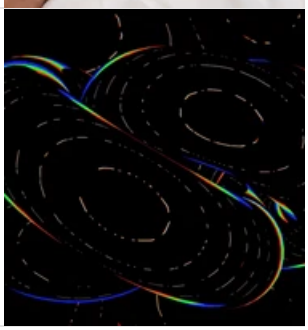

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Scientists Scanned People on DMT Inside fMRI Machines. This Is What They Found.

"By altering these [brain] systems we may be able to construct novel worlds of experience, resonating with the DMT experience."

HD By Hannah Docter-Loeb

March 21, 2023, 10:06am

IMAGE: PATRICKHEAGNEY VIA GETTY IMAGES

Over the years, users have reported that dimethyltryptamine (DMT) can have mind-altering effects. The psychedelic, which is the major psychoactive compound in ayahuasca, is said to have a relatively brief but intense effect on the brain, altering consciousness for minutes rather than hours. Taking DMT is often characterized by vivid and bizarre visions. But no one has ever comprehensively studied brain activity before, during, and after the DMT experience—until now.

ABSTRACT breaks down mind-bending scientific research, future tech, new discoveries, and major breakthroughs.

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In a paper published in *PNAS* on Monday, researchers at Imperial College in London describe their study in which they used advanced brain imaging (fMRI) and EEG to study the effects of the drug on 20 individuals. When the subjects were on DMT, there was increased connectivity across the brain, and more communication between different areas and systems. Brain activity also changed in areas linked with "higher level functions" such as imagination.

Research at Imperial College London, and the study's first author, wrote in an email to Motherboard. "These findings were related also to EEG effects which directly assess electrical activity induced by the brain, thus confirming them further.

Other studies have imaged the brain on psychedelics. However, this is the first to comprehensively image the brain using multiple techniques during a full immersive psychedelic experience.

"This is the first study examining the effects of a psychedelic using multiple neuroimaging methods while the brain is at rest and not doing a task," Timmerman wrote. "This provides opportunities for participants to have full psychedelic experiences and not be distracted."

Timmerman believes that these results may provide some of the most comprehensive insights into the action of psychedelics in humans to date. He points out that it has implications for consciousness research and clinical applications, such as treatment of mental health disorders.

"The advanced human cortex has been linked to how we build our normal experiences of the world," he wrote. "By altering these systems we may be able to construct novel worlds of experience, resonating with the DMT experience. Advanced human systems have also been linked to depression and symptoms of rumination, by dysregulating these systems DMT may have clinical relevance when given together with psychological support."

While this study demonstrates the general action of psychedelics in the brain, further steps are needed to determine exactly how these brain effects are linked to some of the most outstanding psychological experiences a person can experience during DMT trips.

around 10 minutes) by using continuous infusions of DMT to expand that experience further."

Timmerman also stresses that DMT is a psychologically potent drug capable of inducing strong anxiety and fear reactions when not done correctly.

"We performed careful screening to make sure participants were psychologically healthy and make sure we had a medic onsite and people with a background in psychology and therapy to ensure everyone was safe during and after the experience," he wrote.

TAGGED: DMT,WORLDNEWS,DRUGS,PSYCHEDELICS,BRAIN,NEUROSCIENCE,ABSTRACT

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Scientists Discover Alien Life May Exist on Planets We Least Expected in Surprise Find

"I think this narrows the habitability zone a little bit," said the lead author of the study.

By Becky Ferreira

April 18, 2023, 1:37pm

IMAGE: LEV SAVITSKIY VIA GETTY IMAGES

Extraterrestrial life may be more prevalent in an unexpected type of star system, reports a new study. Planets that orbit stars with fewer “metals,” the term for elements heavier than hydrogen and helium, may be more likely to be habitable than worlds hosted by metal-rich stars, according to the research, which focused on the role of ultraviolet (UV) radiation in planetary habitability.

Many researchers have assumed that planets near metal-rich stars would be prime targets for searching for signs of life, especially since this class includes our Sun. The surprising finding could inform the search for aliens, and may eventually have implications for understanding the overall habitability of the universe across time.

ABSTRACT breaks down mind-bending scientific research, future tech, new discoveries, and major breakthroughs.

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Stars are element-making factories that forge materials in their bellies by squeezing atoms together as part of a process called nucleosynthesis. The first

when the stars die, and are then incorporated into new stars that arise from these stellar ashes.

Now, scientists led by Anna Shapiro, an astrophysicist at the Max Planck Institute for Solar System Research, have examined the relationship between the metallicities of stars and the odds that their planets might be habitable. In particular, the team are the first to model the effect of stellar metallicity on the composition of planetary atmospheres, especially the production of ozone, which is a molecule that blocks damaging UV radiation.

The results revealed a bizarre paradox: While metal-poor stars emit more UV radiation than their metal-rich counterparts, the planets orbiting them may have more robust ozone layers that block this harmful light from reaching their surfaces. The unexpected findings "imply that planets hosted by stars with low metallicity are the best targets to search for complex life on land," according to a study published on Tuesday in *Nature Communications*.

"I think this narrows the habitability zone a little bit," said Anna Shapiro in a call with Motherboard that also included study co-author Alexander Shapiro, another astrophysicist at the Max Planck Institute for Solar System Research. "Our research shows that finding life around metal-poor stars is more promising from the point of view of the radiative signature."

That said, both authors emphasized that stellar metallicity and UV surface radiation are only two pieces of a much larger puzzle that faces scientists looking for life on other worlds. While the new study hints that low-metallicity systems may be more conducive to life, that doesn't mean we should stop looking for aliens on planets orbiting metal-rich stars similar to the Sun.

Indeed, the team's new discovery is itself a culmination of a series of surprises about the role that UV radiation plays in the habitability of planets. The origins of the study date back to 2020, when a team of researchers, including Alexander Shapiro, found that the Sun is less active than its solar peers in the galaxy.

As part of that project, Shapiro and his colleagues explored what might happen if the Sun went into a hyperactive state in which it spewed out much more UV radiation. You might expect life on Earth to be irradiated by such an outburst, but the team found that planetary atmospheres can actually become more resistant to harmful light in this situation.

"The paradox is that the increase of the UV outside the atmosphere leads to the decrease of the UV on the ground," Alexander Shapiro said.

This is a key finding because UV light can exact an enormous toll on living things; you may have already had a taste of its power if you've experienced a bad sunburn. Exposure to this type of radiation can cause a host of painful conditions and deadly diseases, including cancer, cataracts, immune system disorders, and DNA damage. Fortunately, Earth is shielded by a layer of ozone that absorbs a huge amount of UV radiation, which has allowed complex multicellular life to emerge and persist on our world.

With this in mind, Anna Shapiro and her colleagues set out to probe the possible connections between a star's metallicity and the potential UV exposure to the surfaces of any planets in the system. The team simulated a host of Earth-like planets orbiting stars with surface temperatures about 5,000°C to about 6,000, which are similar levels to our Sun. The modeled planets were located in the habitable zones of their systems, a region where liquid water might exist on their surfaces.

The odd discovery emphasizes the importance of the exact type of UV light emitted by this range of stars. A shorter band of the ultraviolet spectrum, called UV-C, is absorbed by the upper atmospheres of planets where it actually bolsters ozone production. In contrast, the UV-B band, which is made of longer ultraviolet wavelengths, destroys ozone and is the main component of the deleterious radiation that reaches the surfaces of planets like Earth.

While metal-poor stars emit more UV light overall, they produce a higher ratio of UV-C light to UV-B light compared to metal-rich stars, resulting in more robust ozone layers in the skies of worlds in low-metallicity systems.

“In the case of higher [stellar] activity, the UV-C increases stronger than UV-B and therefore the production of ozone increases,” Anna Shapiro explained. “That's why the ozone layer becomes thicker, and the thicker ozone layer can absorb more UV-B.”

The counterintuitive findings hint at a population of metal-poor systems that contain worlds enveloped by dense ozone layers that ward off UV-B radiation, allowing complex lifeforms to emerge and thrive on the landscapes below.

Given that metal-poor systems grow rarer with each stellar generation, the results also hint that planets around Sun-like stars, known as G-dwarfs, may become more inhospitable in the future.

“What our study shows is that for G-dwarfs, indeed, with time, it will get more and more difficult for the planets to be habitable,” Alexander Shapiro said. However, he added that other types of stars, such as smaller red dwarfs, may not fall into this pattern. For this reason, it’s not yet possible to make broader conclusions about

sophisticated exoplanet models as well as images from next-generation observatories, such as the James Webb Space Telescope, which is currently operating, or the PLAnetary Transits and Oscillations of stars (PLATO) mission, which is due for launch in 2026.

“I think it's going to be really exciting, because we can then check different processes and how they work,” Anna Shapiro concluded.

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